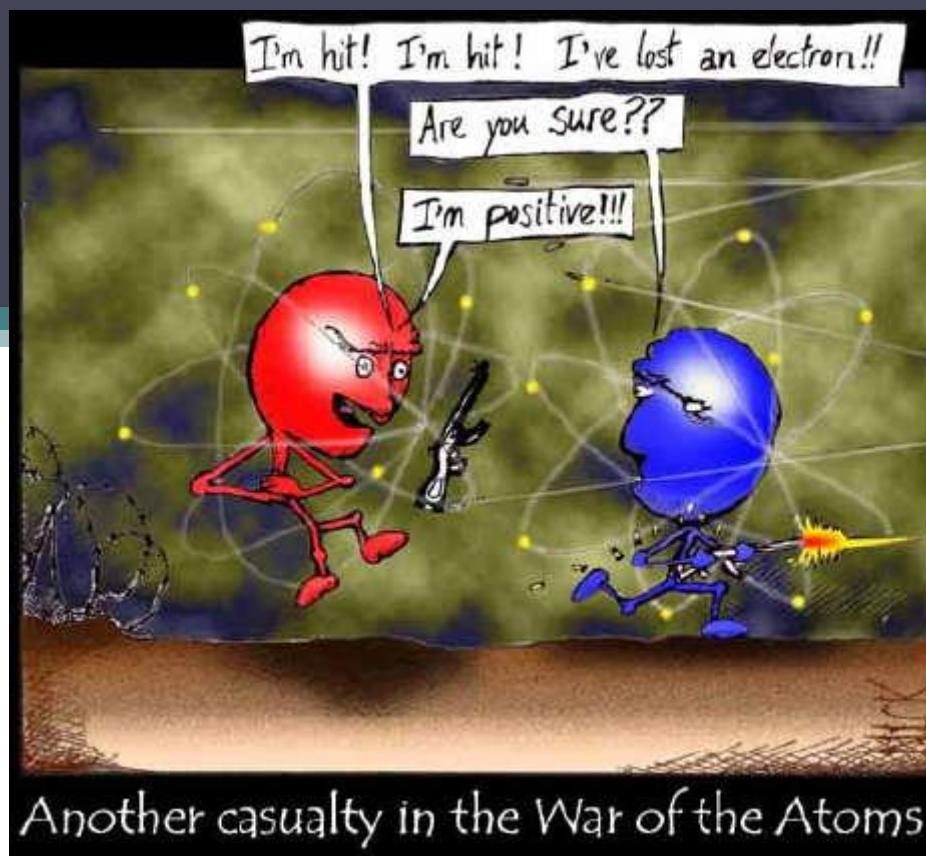


IONIC COMPOUNDS

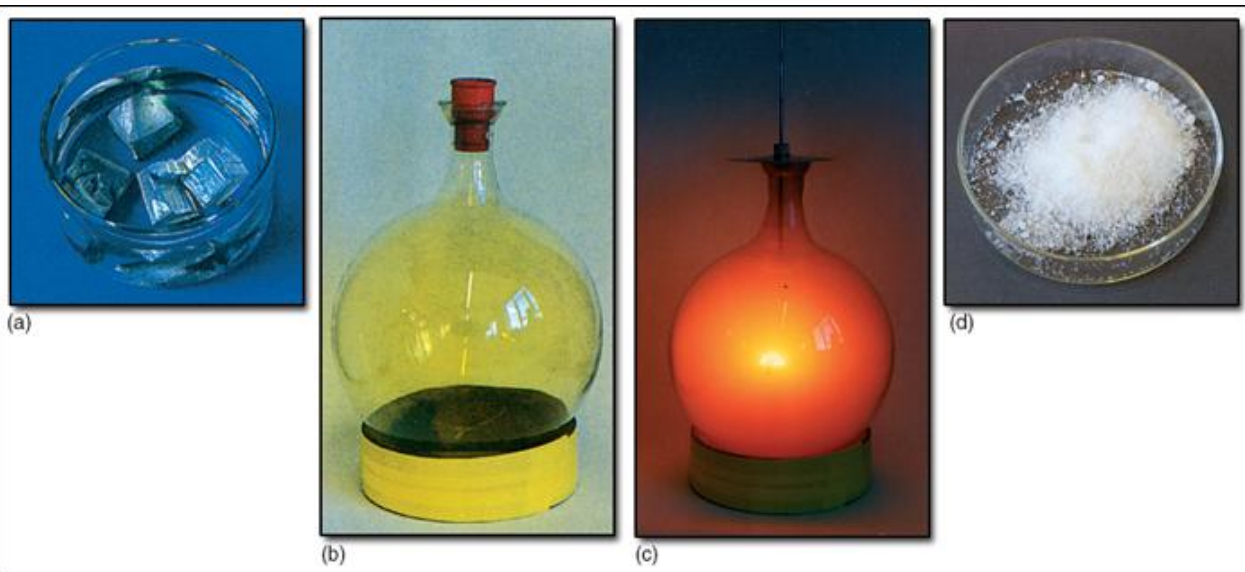


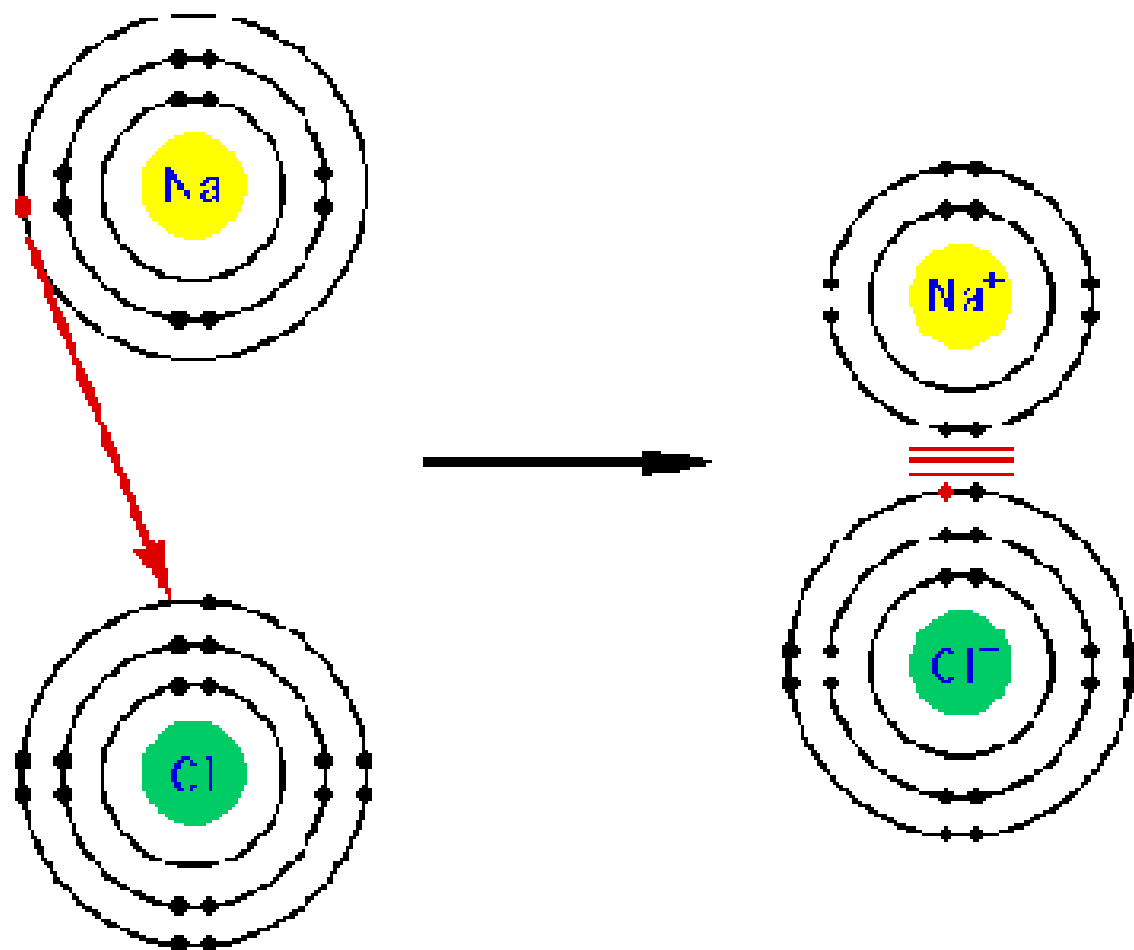
Ionic Compounds

Ionic – the two elements involved form **ions**

Compound- it is the bonding of two **different** elements

- Example: NaCl is a compound. Where Cl_2 is not a compound (but still a **molecule**).





- We will consider three main ways that **ionic** compounds are formed:
 1. **Simple** Metal with non-metal (**binary** compound)
 2. Multivalent **metal** with non-metal
 3. Polyatomic **ions**
- In **each** of these situations the **metal** is always named **first** and it's ending stays the **same**.

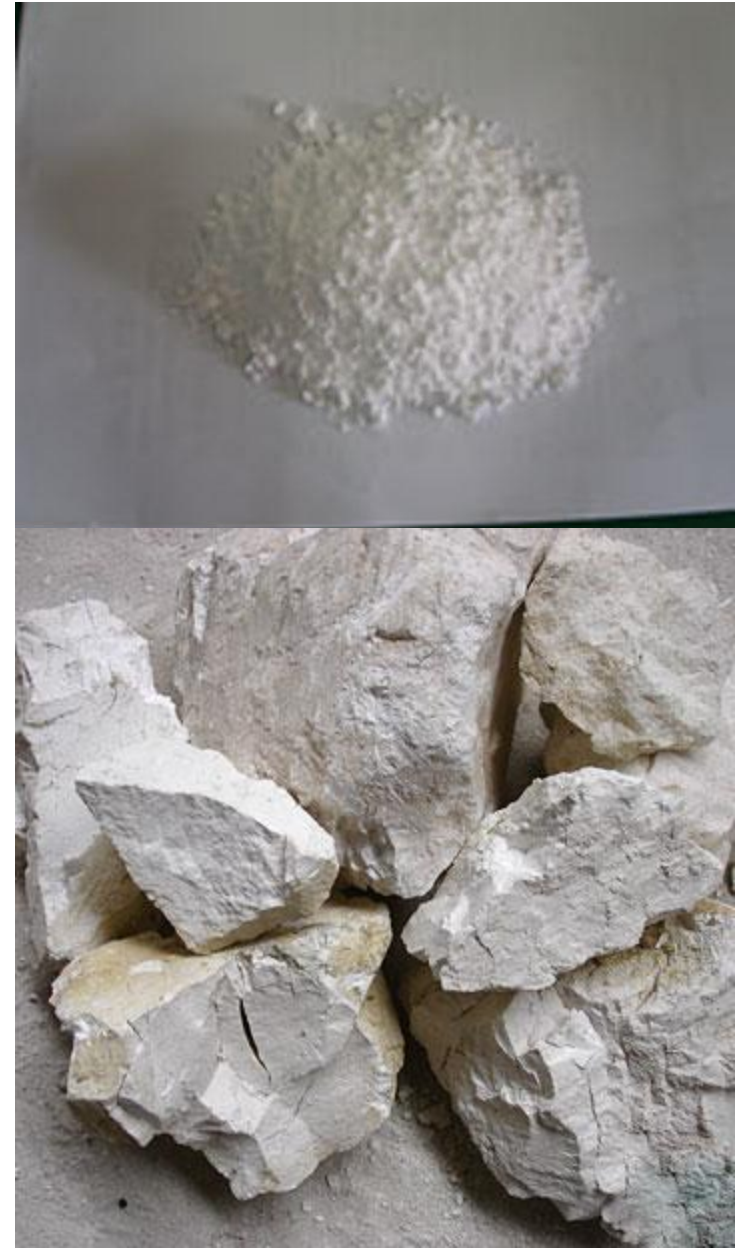
Simple Metal with Non-Metal

Word Name **Rules:**

- **Metal is written first**
- **Non-Metal has ending changed to end in “ide”**

A few examples:

- LiF = Lithium Fluoride
- CaO = **Calcium** Oxide
- CaCl_2 = Calcium **Chloride**



Practice examples:

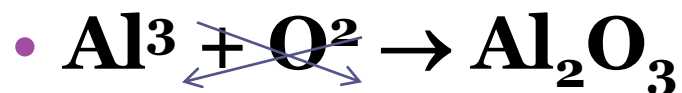
- KCl = **Potassium Chloride**
- BeS = **Beryllium Sulfide**
- Na_2S = **Sodium Sulfide**

Chemical Name

- Rules:
- 1. Look up the ion charges for each element
- 2. Use the Criss Cross Rule
- 3. Simplify

Example

- consider the formation of Aluminum Oxide.
Aluminum has an ion charge of 3 **Oxygen** has an ionic charge of 2
- $\text{Al}^3 + \text{O}^2 \rightarrow$



- Practice a few more:
- Beryllium Oxide = **BeO** (not Be_2O_2 ! We have to reduce the subscripts to lowest term)
- Beryllium Nitride = **Be₃N₂**
- **Beryllium Fluoride** = BeF_2

Questions

1. Which of the following are ionic compounds?

- Oxygen gas O_2 (no, covalent bond)
- Magnesium Oxide MgO (yes)
- Potassium Iodide (yes)
- Nitrate NO_3^- (These two non-metals are sharing electrons to form covalent bond.)

2. Write the chemical symbol for the following atoms and ions.

- Hydrogen atom = H
- Lithium atom = Li
- Lithium ion = Li^+
- Calcium ion = Ca^{+}
- Argon atom = Ar
- Chlorine ion = Cl^-

3. Name the following ionic compounds.

- CsCl = Cesium Chloride
- KCl = Potassium Chloride

Multivalent Metals

- Take the time to use the Periodic Table and write the possible ionic charges for the common multivalent metals:

Titanium = **4+** **3+**

Chromium = **3+** **2+**

Manganese = **2+** **3+**

Iron = **3+** **2+**

Cobalt = **2+** **3+**

Nickel = **2+** **3+**

Copper = **2+** **1+**

Tin = **4+** **2+**

Platinum = **4+** **2+**

Gold = **3+** **1+**

Lead = **2+** **4+**

Multivalent metal with non-metal

- Some of the metals can form **different** ions. For example consider Iron (element **26**). It can be Fe^{+2} **or** Fe^{+3} .

One rule addition:

- **Indicate which ionic charge with Roman numeral after metal name.**

Word Name Example

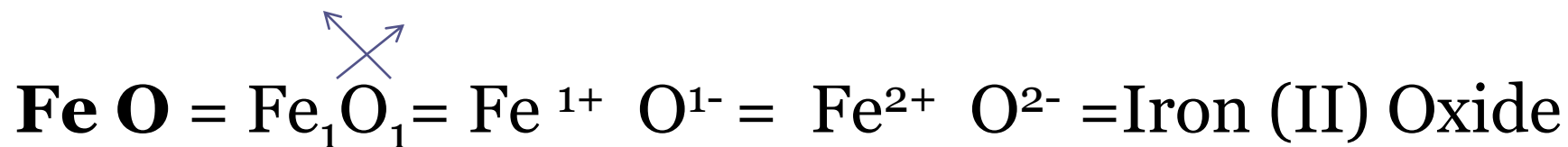
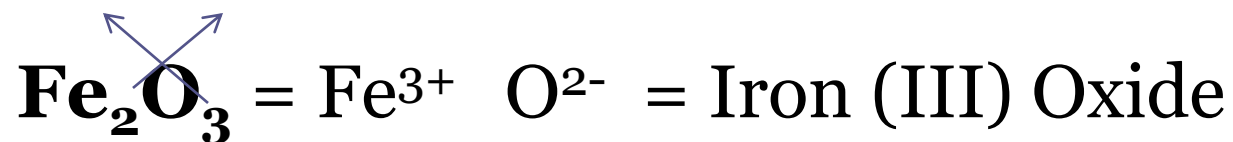
- ***Copper (II) Sulfide***
- $\text{Cu}^2 \text{S}^2$ (criss cross)
- Cu_2S_2 (reduce)
- CuS

Write the chemical formula for each compound:

- Tin (II) Chloride = **SnCl₂**
- Titanium (II) Oxide = **TiO**
- Titanium (IV) Oxide = **TiO₂**

Chemical Formula Example

- Use the **backward** criss-cross method to determine the ion charge of iron.



- If no subscripts are written, there is 1 atom. Since iron does NOT have an ion charge of 1+, the charge must have been reduced

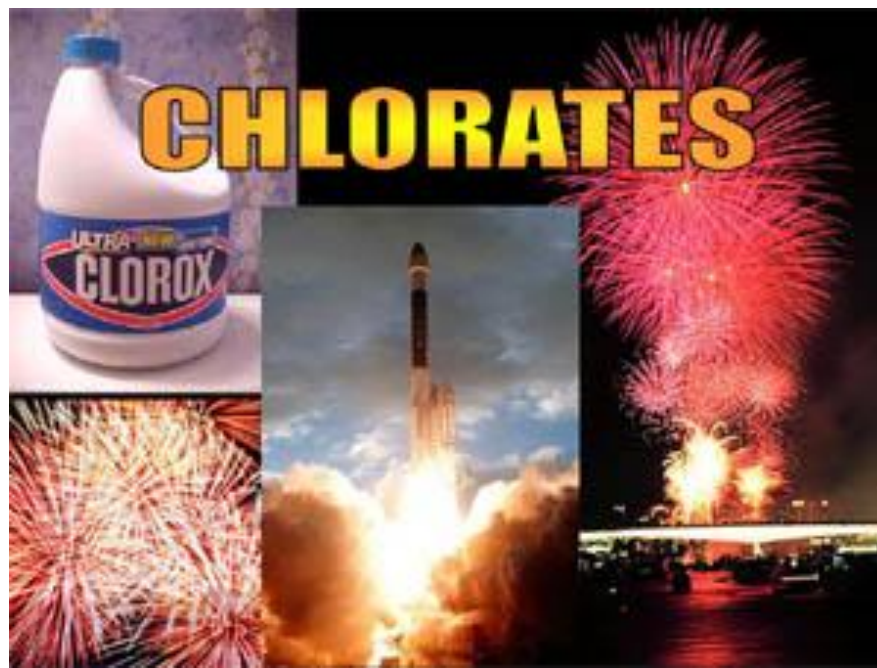
Practice

Write the name for each compound:

- PtS_2 = **Platinum (IV) Sulphide**
- PtBr_2 = **Platinum (II) Bromide**
- Au_2S = **Gold (I) Sulphide**
- Au_2S_3 = **Gold (III) Sulphide**
- CuCl = **Copper (I) Chloride**

Polyatomic Ions

- The word polyatomic means “**many**” atoms. Polyatomic ions are often **negative** ions made of more than one non-metal.



Examples (from the back of the periodic table)

Carbonate	CO_3^{2-}
Chlorate	ClO_3^-
Chromate	CrO_4^{2-}
Nitrate	NO_3^-
Nitrite	NO_2^-
Phosphate	PO_4^{3-}
Phosphite	PO_3^{3-}
Sulphate	SO_4^{2-}
Sulphite	SO_3^{2-}
Hydroxide	OH^-

Rule

- **Treat each polyatomic atom as a group that cannot be separated and use brackets if needed.**

Practice

- Write the chemical formula or name for each of the compounds:

1. Sodium Carbonate = **$\text{Na}_2(\text{CO}_3)$**

2. Potassium Nitrate = **KNO_3**

3. Calcium Hydroxide = $\text{Ca}(\text{OH})_2$

4. Copper (II) Sulphate = CuSO_4

5. Barium Sulphate = BaSO_4